

1. Record Nr.	UNISA996466747703316
Autore	Sabbagh Harold A.
Titolo	Advanced electromagnetic models for materials characterization and nondestructive evaluation // Harold A. Sabbagh [and three others]
Pubbl/distr/stampa	Cham, Switzerland : , : Springer, , [2021] ©2021
ISBN	3-030-67956-X
Descrizione fisica	1 online resource (353 pages) : illustrations
Collana	Scientific Computation
Disciplina	620.1127
Soggetti	Nondestructive testing Electromagnetic testing
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Intro -- Preface -- Acknowledgments -- Contents -- Part I Voxel-Based Inversion Algorithms -- 1 A Bilinear Conjugate-Gradient Inversion Algorithm -- 1.1 Optimization via Nonlinear Least-Squares -- 1.2 A Bilinear Conjugate-Gradient Inversion Algorithm Using Volume-Integrals -- 1.3 The Algorithm -- 1.4 Example: Raster Scan at Three Frequencies -- 2 Voxel-Based Inversion Via Set-Theoretic Estimation -- 2.1 The Electromagnetic Model Equations -- 2.2 Set-Theoretic Estimation -- 2.3 Statistical Analysis of the Feasible Set -- 2.4 A Layer-Stripping Algorithm -- 2.5 Some Examples of the Inversion Algorithm -- 2.6 Application to Aircraft Structures -- Part II Materials Characterization -- 3 Modeling Composite Structures -- 3.1 Background -- 3.2 Constitutive Relations for Advanced Composites -- 3.3 Example Calculations Using VIC-3D® -- 3.4 A Coupled-Circuit Model of Maxwell's Equations -- 3.5 Eddy-Current Detection of Prepreg FAWT -- 3.6 An Anisotropic Inverse Problem for Measuring FAWT -- 3.6.1 Return to an Analysis of Fig.3.10 -- 3.7 Further Results for Permittivity -- 3.8 Comments and Conclusions -- 3.9 Eigenmodes of Anisotropic Media -- 3.10 Computing a Green's Function for a Layered Workpiece -- 3.11 An Example of the Multilayer Model -- 3.12 A Bulk Model -- 4 Application of the Set-Theoretic Algorithm to CFRP's -- 4.1 Background -- 4.2 Statistical Analysis of the Feasible Set -- 4.3 An Anisotropic Inverse Problem for Measuring FAWT -- 4.3.1 First Set-

Theoretic Result -- 4.3.2 Second Set-Theoretic Result -- 4.3.3  
Comment -- 4.4 Modeling Microstructure Quantification Problems --  
4.4.1 Delaminations -- 4.4.2 Transverse Ply with Microcrack -- 4.5  
Layer-Stripping for Anisotropic Flaws -- 4.6 Advanced Features for  
Set-Theoretic Microstructure Quantification -- 4.6.1 A Heuristic  
Iterative Scheme to Determine a Zero-Cutoff Threshold.  
4.7 Progress in Modeling Microstructure Quantification -- 4.8 Handling  
Rotations of Anisotropic Media -- 5 An Electromagnetic Model for  
Anisotropic Media: Green's Dyad for Plane-Layered Media -- 5.1 Theory  
-- 5.2 Applications -- 5.3 Some Inverse Problems with Random  
Anisotropies -- 5.4 Detectability of Flaws in Anisotropic Media:  
Application to Ti64 -- 6 Stochastic Inverse Problems: Models and  
Metrics -- 6.1 Introducing the Problem -- 6.2 NLSE: Nonlinear Least-  
Squares Parameter Estimation -- 6.3 Confidence Levels: Stochastic  
Global Optimization -- 6.4 Summary -- 7 Integration of Functionals,  
PCM and Stochastic Integral Equations -- 7.1 Theoretical Background --  
7.2 Probability Densities and Numerical Procedures -- 7.3 Second-  
Order Random Functions -- 7.4 A One-Dimensional Random Surface --  
7.5 gPC and PCM -- 7.6 HDMR and ANOVA -- 7.7 Determining the  
ANOVA Anchor Point -- 7.8 Interpolation Theory Using Splines Based  
Upon Higher-Order Convolutions of the Unit Pulse -- 7.9 Two-  
Dimensional Functions -- 7.10 Probability of Detection and the  
Chebychev Inequality -- 7.11 Consistency of Calculations -- Appendix  
1: The Numerical Model -- Appendix 2: The Fortran RANDOM\_NUMBER  
Subroutine -- 8 A Model for Microstructure Characterization -- 8.1  
Introduction -- 8.2 Stochastic Euler Space -- 8.3 The Karhunen-Loeve  
Model -- 8.4 Anisotropic Covariances -- 8.5 The Geometric  
Autocorrelation Function -- 8.6 Results for the Anisotropic Double-  
Exponential Model -- 9 High-Dimension Model Representation via  
Sparse Grid Techniques -- 9.1 Introduction -- 9.2 Mathematical  
Structure of the Problem -- 9.3 Clenshaw-Curtis Grids -- 9.4 The  
TASMANIAN Sparse Grids Module -- 9.5 First TASMANIAN Results --  
9.6 Results for 4D-Level 8 -- 9.7 The Geometry of the 4D-Level 8  
Chebyshev Sparse Grid -- 9.8 Searching the Sparse Grid for a Starting  
Point for Inversion.  
9.9 A Five-Dimensional Inverse Problem -- 9.10 Noisy Data and  
Uncertainty Propagation -- 10 Characterization of Atherosclerotic  
Lesions by Inversion of Eddy-Current Impedance Data -- 10.1 The  
Model -- 10.2 Sample Impedance Calculations -- 10.3 The Eight-Layer  
Inversion Algorithm -- 10.4 Lesion 2 -- 10.5 Noninvasive Detection  
and Characterization of Atherosclerotic Lesions -- 10.6  
Electromagnetic Modeling of Biological Tissue -- 10.6.1 The Lesions  
Revisited -- 10.7 Determining Coil Parameters -- 10.7.1 Application to  
the 21.6mm Single-Turn Loop -- 10.8 Measuring the Frequency  
Response of Saline -- 10.9 Determining the Constitutive Parameters of  
Saline -- 10.10 Comments and Discussion -- 10.10.1 Summary --  
Appendix: The Levenberg-Marquardt Parameter in Least-Squares  
Problems -- Part III Quantum Effects -- 11 Spintronics -- 11.1  
Introduction -- 11.2 Paramagnetic Spin Dynamics and the Spin  
Hamiltonian -- 11.2.1 Application to  $\text{Fe}^{3+}:\text{TiO}_2$  -- 11.2.2  $\text{Ho}^{3+}:\text{CaF}_2$   
-- 11.3 Superparamagnetic Iron Oxide -- 11.4  $\text{Fe}^{3+}$  and Hund's Rules  
-- 11.5 Crystalline Anisotropy and  $\text{TiO}_2$  -- 11.5.1 Application to a  
'Magnetic Lesion' -- 11.6 Static Interaction Energy of Two Magnetic  
Moments -- 12 Carbon-Nanotube Reinforced Polymers -- 12.1  
Introduction -- 12.2 Modeling Piezoresistive Effects in Carbon  
Nanotubes -- 12.2.1 The Structure of CNTs -- 12.3 Electromagnetic  
Features of CNTs -- 12.4 Quantum-Mechanical Model for Conductivity  
-- 12.5 What Are We Looking At? -- 12.6 An Example of a Bianisotropic

System -- 12.7 Modeling Paramagnetic Effects in Carbon Nanotubes --  
12.7.1 Paramagnetic Spin Dynamics and the Spin Hamiltonian -- 12.7.2  
Application to Fe<sup>3+</sup>:TiO<sub>2</sub> -- 12.7.3 Superparamagnetic Iron Oxide --  
Two Spins -- Three Spins -- 12.8 Inverse Problems -- 12.8.1 Inverse  
Problem No. 1 -- 12.8.2 A Thermally-Activated Transport Model --  
12.8.3 A Simple Inverse Problem.  
12.8.4 Voxel-Based Inversion: A Surface-Breaking Checkerboard at  
50MHz -- 12.8.5 Voxel-Based Inversion: A Buried Checkerboard --  
12.8.6 Spatial Imaging Using Embedded CNT Sensors -- 12.8.7 Inverse  
Problem No. 2: Characterizing the CNT via ESR -- 12.8.8 What Does  
VIC-3D® Need? -- References -- Index.

---